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The Geology of Basutoland.

BY

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Notes on the Geology of Basutoland.

By the Rev. S. S. Dornan.

THE rocks composing Basutoland belong to the Stormberg Series of the Karroo System. They cover a much larger area than Basutoland, extending into the Orange River Colony on the west and north, on the south and east into Cape Colony and Natal, and, I am informed, across the Vaal into the Transvaal. The area is thus not less than 45,000 square miles. The whole of that part of the Orange River Colony known as "the Conquered Territory," east of a line drawn from Thaba 'Nchu to Vrede, is occupied by the whole or portions of these rocks.

The average thickness of the rocks is as follows :—

	Designation.	*Thickness of feet.*
	Recent and superficial accumulations	20–40
Stormberg Series.	(1) Volcanic Beds	600–4000
	(2) Cave Sandstone	150–400
	(3) Red Beds...	300–500
	(4) Molteno Beds (base not seen)	600 exposed.

The rocks are, as a rule, well exposed, owing to the great denudation the country has undergone. The thickness is very uniform all over the country from north to south, as at Qalo, near Botha-Bothe :

	feet.
Volcanic Beds	400
Cave Sandstone	250
Red Beds	350
Molteno Beds	450

and at Sebapala in the extreme south-east :

	feet.	
Volcanic Beds	1000	
Cave Sandstone	200	
Red Beds	400	
Molteno Beds	150	exposed in places.

As one advances farther into the hills the Volcanic Beds become much more prominent rock features, as they compose the highest ranges of mountains, termed Maluti in Sesuto. In addition to these rocks there is a vast network of intrusive sheets and dykes traversing the various members of the Stormberg Series.

(4) The Molteno Beds are composed of sandstones, shales, and mudstones, usually grey or greenish in colour, with occasional bands

of conglomerate. When freshly fractured the sandstone presents a highly glittering appearance. Nodules of mud are of frequent occurrence, and most of the sandstone is of a loose texture. The rocks weather very fast. At Morija the shales contain numerous plant-remains referable to *Thinnfeldia* and *Stenopteris*. Fragmentary reptilian remains occur in the sandstones. The largest portion I have yet found is the upper part of the humerus of a Dinosaur; the species to which it belongs has not been determined. The cast of a Cephalopodous shell was found by the writer in the Molteno Sandstones close to Morija, and I have heard of a similar discovery near Ficksburg. The Molteno Beds contain thin seams of coal, varying in thickness from 1 inch up to 6 inches. Usually the seams only extend a short distance and then break up into pockets. The coal is soft and of indifferent quality, but occasional seams of good quality are to be found, as for example at Mohale's Hoek, where a seam 6 inches thick exists of most excellent quality. It is worked to some extent by the natives. The plants composing the coal seem to have grown, generally speaking, in marshy depressions, as the presence of occasional trunks of trees in the sandstones indicates an old land surface. I am aware that this is not the usual view held of the origin of the coal, but from observations at widely different places I have come to the conclusion that the drift origin of the coal-beds is not generally true. These seams of coal are widespread over the country, being found at places as far apart as 70 or 80 miles. The Basutos do not usually dig this coal. They try to conceal its whereabouts as much as possible, for fear of the white man seizing the country, and, with the example of other parts of South Africa before their eyes, one cannot wonder at their action.

About 50 feet above the horizon upon which the coal is found there is a bed of deep red conglomerate, containing pebbles of quartzite, evidently derived from Cape or pre-Cape rocks, varying in size from a pea up to masses six or eight inches in diameter. The presence of these blocks must imply a considerable distance in transportation, as no rocks of this character occur nearer, I understand, than Pondoland, Griqualand West, or the Transvaal. As most of the ripple-marks in the sandstones indicate a current with an east to west direction, it is more likely they came from the first-mentioned place. This conglomerate is highly charged with ferruginous matter, so that its appearance is very characteristic. The thickness of the bed varies from three to five feet. This bed is usually taken as indicating coal beneath in Cape Colony, and I can confirm this from personal observation in Basutoland. It seems to be the higher of the two horizons upon which coal is found in the Molteno Beds. The lower is not exposed in Basutoland. The conglomerate is remarkably uniform and persistent all over the country, just a little above the plain, and in every exposure I have found indications of the presence of coal beneath. Good exposures of the Molteno Beds are difficult to obtain in Basutoland owing to the amount of detritus, which covers the slopes of the hills where they lie. This does not apply to the Red Beds and Cave Sandstone, splendid exposures of which occur everywhere.

Fossils,[1] except plants, are not plentiful, principally owing to the absence of good exposures, and also owing to the jealousy of the natives, which prevents any systematic search. Scattered bones occur, but I have seen no skulls or complete skeletons. The species to which these bones belong have not been determined. Large fossilised trunks of trees as much as 2 feet in diameter are not uncommon. These would indicate a land surface, at no great distance, or they may have been floated down by a river.

(3) The Red Beds lie conformably upon the Molteno Beds without any distinct line of separation, so that it is difficult to say where the one ends and the other begins. The name is an unfortunate one, and as the rocks are so characteristic and so persistent all over the country, the name could be very well changed in favour of some other designation. They are composed of red sandstones, blue, green, and chocolate-coloured mudstones and shales, the mudstones as a rule predominating. It is noteworthy that most of the green mudstones weather red, which gives the red portions of the beds an apparent thickness much greater than they really have. Ripple-marks and false bedding are extremely common, and nearly always indicate a current from an easterly and north-easterly direction. No plants have been found so far. Fossil wood is rather plentiful, and, of late, reptilian bones have been found in the Orange River Colony and North Basutoland in considerable numbers, indicating large and small Dinosaurs. The largest thigh-bone I have seen measures 19½ inches in circumference at the upper extremity of the shaft. Near the Caledon River outside of Ficksburg a large quantity of bones was recently found belonging to individuals of various sizes, and presumably of different species. The bones are broken and mixed up together as if they had been swept down into their present position by a flood. They are embedded in chocolate-coloured mudstone. So plentiful are they that a farmer has built the walls of his cattle kraal of blocks of stone containing fragments of bones.[2] In this band of mudstone are curious circular bombs of clay, filled with fine glassy sand, with a central nucleus of limestone, so that they look like howitzer shells. The diameter of these concretions is usually about 10 or 12 inches, and the thickness of the clay layers about 8 inches. The local name for them is "Basuto pots," and the term is certainly not inapplicable, as on breaking in the top the whole of the contents can be emptied out. Nodules are of frequent occurrence all through the Red Beds, and are more or less common through the whole of the Molteno Red Beds and Cave Sandstone. Silicified wood is fairly plentiful in the Red Beds,

[1] Since this was written footprints of reptiles have been discovered in Molteno Beds near the Tsuaieng River about 1½ hour's ride from Morija. They are four-toed and about 6 inches square, and belonged to some heavy-footed animal similar to a *Pareiasaurus*, but certainly not this animal. They strongly resemble Labyrinthodont tracks. I am also informed by Mr. H. C. Sloley, Resident Commissioner of Maseru, that a skeleton of a Dinosaur of large size was found in the bed of the Tebetebeng River, and curiously enough was lying alongside of a doleritic dyke.

[2] The Rev. H. Dieterlen, of Leribe, has a vertebra of a Dinosaur, 6 inches in length, which is said to have come from Red Beds, and also near his station there is a portion of an arm-bone, embedded in grey mudstone, just at the base of the Red Beds.

but the remains are mostly fragmentary; the largest portion of a tree I have seen measures 4 feet in length and 1 ft. 10 in. in diameter. It occurs between Cana and Hlotse. The Red Beds in many places must have been deposited in shoal water, as ripple-marked sandstone is very common, so much so in fact that the Rev. D. F. Ellenberger, of Masitisi, has built one of his outhouses and flagged all his floors with slabs of the most beautifully ripple-marked sandstone belonging to the upper members of the Red Beds. Fossil fishes have been found in the bed of the Telle River said to belong to the genus *Semionotus*, but I am not able to vouch for the accuracy of this. I understand these fish eventually found their way to the British Museum. Spines of a small carnivorous Dinosaur, *Massospondylus*, have also been found in the neighbourhood of Masitisi. The Red Beds are remarkably uniform in thickness and appearance all over the country. They have been traced for nearly 100 miles in practically a straight line without any marked difference, the average thickness being about 300 feet. In some places in South Basutoland they are 400 feet thick. They lie nearly horizontally on the Molteno Beds, partaking of their general easterly dip.

(2) The Cave Sandstone is extremely difficult to separate from the underlying Red Beds, which pass up into it without any marked difference. Thus there is no definite line of demarcation; Red Beds occur in what I consider Lower Cave Sandstone, but the Cave Sandstone is distinguished, especially in its upper members, by its greater massiveness, and also by its prevailing grey colour. It forms precipices round the tops of the hills, in many cases overhanging. The individual beds are very thick, and the rock does not readily split into laminæ. The Cave Sandstone weathers into huge pillars, or breaks off in immense blocks hundreds of tons in weight. These strew the hillsides everywhere, so that one can always tell when one is in the neighbourhood of this rock by the character of the fallen blocks on a slope. A good example of the pillar formation is to be seen at the station of Thaba Bosin. A small hill named Qiloane, evidently at one time connected with Thaba Bosin mountain, but now separated by a valley a mile wide and over 600 feet deep, is crowned by a pillar of Cave Sandstone some 100 feet high. It is about 15 feet broad on top, and is composed of three immense steps gradually tapering to a point. The precipices of the Cave Sandstone are usually covered with a blackish glaze, the effects of sun and rain, which renders them very slippery. The rock is perforated with openings, especially near the crests of the hills, but though these openings have given the rock its present name they are not true caves, being usually due to the more rapid erosion of the bands of blue clay with which the rock is interstratified, especially in its lower members. They are merely shelters with overhanging ledges. Instances of true caves do occur, but they are uncommon. The Bushmen inhabited these caves in former times, and also cannibals—the remnants of tribes broken up by Chaka and Umsilikazi in their sanguinary raids and driven to cannibalism by fear and starvation.[1] One very large cave near the

[1] Voyage d'exploration, par M. Arbousset, 1836.

station of Cana is still called the Cannibals' Cave, and the people point out the ledge upon which the cannibals slaughtered their victims, appealing to the blood-stains on it in proof of their assertion. Needless to say, the ledge is nothing more than green mudstone, which has weathered red. The Bushmen have left traces of their occupation of the country in the paintings on the walls of these rock shelters. Many of these paintings are remarkable for their finish and accuracy of delineation. One of the largest series of paintings is to be found two hours from the station of Thaba Bosin. On the rock face are hundreds of paintings of elands, some of them 24 inches long and 9 inches high, hartebeest, 'gnu, storks, and jackals, all in the natural colours of the animals. The bodies of the elands are painted brown, while the neck, head, and belly are white. Mixed with these are scores of men in rows with bows and arrows, evidently fighting. At one place a Bushman is stealing up to a hartebeest grazing in rather long grass, with his arrow on the string. At another place we can see the hunter charged and knocked over by the infuriated animal he has just shot. On another part of the rock lions are depicted in their tawny colour, some leaping upon game, others on the *qui vive*. Then there are jackals and curious drawings representing snakes or perhaps mythological signs. Unfortunately most of the paintings have been spoiled by the fires made by the Basuto herd boys. The Basuto see no beauty in and put no value upon these paintings, and their wanton destruction is very often encouraged by the chiefs themselves, in order to prevent Europeans from visiting the country. Other beautiful sets of paintings occur at Sehonghong on the Upper Orange River, the finest set in the country, at Hermon, Thabana, Morena, Masitisi, Kolo, Qeme, Teyateyaneng, Qalo, and many other places. Those at Masitisi are remarkably good, but the figures are small. They are comparatively recent, certainly within 70 years or so, as horses and riders are depicted upon them, and these animals were not brought into Basutoland till the early part of last century.

Fossils are comparatively rare in the Cave Sandstone, but although the actual remains of the animals are seldom met with their footprints are fairly common. The remains of the forearm and part of the shoulders of a Dinosaur, species undetermined, occur at Sebapala.[1] The footprints of Dinosaurs of large size occur at the following places, all in a band of green mud about 18 inches thick, viz., Tsikuane, Qalo, Morija, and Teyateyaneng. Those at Qalo are most distinct, showing the corrugations of the skin. The largest prints are 14½ inches long by 10 wide. Other impressions are shown in relief on the roof near by. The animals walked from west to east up-stream, over the bed of a river, as indicated by the ripple-marks, similar to what one sees every day in the beds of all the large rivers. This green mudstone is interesting as it lies on a jagged surface of coarse sandstone, and points to some denudation having previously taken place.

At Tsikuane, 25 miles further south-west, a magnificent series of dinosaurian footprints are to be seen in the same green mud, on the underside of an overhanging cliff. They are all in relief. The huge

[1] Part of a jaw was found near Morija ; it probably belongs to *Hortalotarsus*.

block which has broken off, with the impressions in their natural state, lies below. There are more than 50 of these prints all with the same general direction from west to east, but crossing and recrossing each other in the most extraordinary fashion. Large and small are mixed up together, but the great bulk of them are small prints. There are two sets of very large prints most conspicuous, evidently belonging to two large individuals. The length of these tracks is not less than 15 inches (middle toe). They are all of the three-toed variety. A study of these footprints, which ramble about a great deal, shows that they were probably not all made at one time, as some have been imprinted on the others subsequently, when they had to some extent hardened, for if they had all been formed at the same time the first would have obliterated the second. One is irresistibly driven to the conclusion that these prints belong to a single family of Dinosaurs. This would imply that Dinosaurs were rather prolific, or that their families remained with them a long time. Another and more probable suggestion is that the animals were gregarious.[1]

At Morija, 75 miles further south-west, there are two slabs containing dinosaurian tracks. The smaller contains one large and a few small impressions. The larger slab is many tons in weight, and in falling has split into two, showing the tracks in reverse. It contains three different sets of impressions large and small, belonging to individuals of different sizes and possibly of different species. Here the same crossing of prints occurs as at Tsikuane. The middle toe of the largest track is 15 inches long, and the stride 3 ft. 3 ins. to 5 feet. Besides these impressions it contains well-preserved sun-cracks, showing that the animals walked over the muddy flats of a lake or river before they were dry. These tracks occur in the same band of green mud as at Tsikuane and Qalo, with ripple-marks and sun-cracks, just what one sees on the muddy bottoms of many of the large rivers to-day.

Of all the animals of the Stormberg Beds the Theriodonts are the most interesting, as they bear strong resemblances to mammals. Dr. Broom, of Stellenbosch, says they have practically solved the problem of the origin of mammals. Of these Theriodonts only two are said to have come from Basutoland, both of small size, viz. *Galesaurus* and *Tritylodon*. They are only known from their skulls. I have not been able to discover whether they came from Molteno Red Beds or Cave Sandstone, but I imagine most likely from the first. *Tritylodon* has a small and decidedly mammalian-like skull, and is said to have been found at Thaba Tsuen, a mountain 16 miles south-west of Morija. It was brought to England by Dr. Exton, Curator of the Bloemfontein Museum, and described by Sir Richard Owen at a meeting of the Geological Society in 1884.[2] Dr. Broom, who has recently discussed the affinities of the skull, inclines to the view that it is a mammal.

(1) The volcanic beds are by far the most typical rock features of the country. They are confined to the high ranges of the Malutis,

[1] Since writing this, further study of these footprints has convinced me that what I took to be footprints partially obliterated by others made long subsequently were only the partial obliteration made by the hind-feet of animals following the others immediately.

[2] See Quart. Journ. Geol. Soc., vol. xl (1884), pp. 146–151, pl. vi.

which form the backbone of the country. The Malutis consist of at least two and in most places three or four parallel ranges of mountains. The average height is 7,500 feet. The necks seem to lie in three or four lines, roughly corresponding to the ranges which now form the Malutis and Drakensberg. A study of the present river system of the country bears out this view, as the Orange River and the Caledon run in approximately parallel courses, and this specially applies to the tributaries on the right or northern bank of the Orange River. The first range of necks builds up the great mountains known as Bitsolebe, Machache, Thaba Phutsoa, and Matelile. The next range, 25 miles to the south-west, contains the great necks known as Dikolobeng, Mokhele, and Thaba di Noha. To the north and east of this there is another composed of still higher summits, amongst them not only the highest in Basutoland but in the whole of South Africa, namely, Mount Hamilton 11,500 feet, Leteba's Nek 10,842 feet, Motar 10,400 feet, and Bukotabelo 10,000 feet. The last range composes the mighty wall known as the Drakensberg, and includes the Mont aux Sources 11,170 feet, Champagne Castle 10,357 feet, Giant's Castle 9,657 feet, and many others. Besides these well-defined ranges, there are many other smaller ones scattered around and between them. It must be remembered that many of these heights are not absolutely reliable, as no proper surveys have been made.

The volcanic beds consist of vast piles of lavas and ashes. Siliceous tuffs are not plentiful. I have seen two or three small examples. The thickness ranges from 500 to 4,000 feet. The lavas are amygdaloid and doleritic near the base of the group, often columnar near their junction with the Cave Sandstone. Higher up in the group truly vesicular and scoriaceous varieties occur, interbedded with thick deposits of ash purple in colour. The greater part of the lavas is amygdaloid, with the cavities filled with quartz or calcite. Weathered surfaces on the lavas indicated by bands of red clay are entirely absent. The thickness of the individual beds varies very much, from a few inches up to 20 feet or more. Many of the flows are full of pipe-like vesicles, usually from 4 to 6 inches in length and from $\frac{1}{2}$ to $\frac{2}{5}$ of an inch in diameter, filled with calcite. These vesicles are not quite perpendicular to the plane of the bed, but inclined towards the vent from which the flow took place. They are more or less spherical and often branch at the top. Occasionally the calcite is completely weathered out, leaving the pipes open, so that a bed of lava at its surface and along its fractured edges looks not unlike a honeycomb. Most of the lavas are basalts, but andesites occur, not only intermingled with the others, but composing entire hills themselves, as at the magistracy of Mayeni in South Basutoland. Agglomerate necks are of frequent occurrence, filling up the great vents, and also in small isolated necks. Most of the indications presented by the lavas of Basutoland point to their deposition in water. This, however, is difficult to reconcile with the fact that in two instances where the junction of the lavas and the Cave Sandstone is exposed, the former rest on the eroded surface of the latter. The upper members of the Cave Sandstone seem also to have been removed by denudation prior to the deposition of the volcanic beds. In the lower flows of the group

thin intercalated beds of sandstone occur, pointing to an interruption of volcanic activity, the thickest being 3½ feet. A short description of two of these volcanic peaks, Thaba 'Telle and Thaba di Noha, will serve as examples of all the rest.

Thaba 'Telle is a mountain about 7,800 feet high, rising abruptly from a platform of Cave Sandstone. Its lower slopes consist of doleritic lavas, alternating with vesicular varieties and beds of purple ash, and at the top of agglomerate, evidently the remains of the old throat. The lavas are just under 2,000 feet in thickness. The mountain is a kind of three-sided cone, with steep, often precipitous sides, and was once much more extensive than now. The summit is a plug of naked agglomerate standing up to a height of fully 100 feet, exceedingly steep and in some places overhanging. It can only be climbed at one point where there is a crack left by the weathering away of a doleritic dyke, and then only with considerable difficulty and risk. The top is convex and grass-grown about 30 square yards in area. The view from the summit is magnificent, as several prominent volcanic peaks can be seen in the distance. This plug is the resort of multitudes of vultures that make their homes in the cracks and fissures of the rock. The lavas of Thaba 'Telle are full of steam holes, more especially in the upper beds, and about the middle of the beds are two thick deposits of ash separated by a thin bed of amygdaloid lava. This alternation of beds can be made out at some distance, as the ash is light purple in colour, and the lava a deep shining black. The same phenomenon occurs elsewhere. Near the base of the mountain is a large intrusive sheet surrounding what was once a subsidiary cone, but what is now nothing more than a mere plug of doleritic lava and agglomerate. This sheet is of much later date than the surrounding lavas which it penetrates and overlies. From it spring two immense dykes that traverse the country for miles in practically straight lines.

Thaba di Noha. This mountain is about 50 miles, as the crow flies, from Thaba 'Telle, and rises immediately behind the magistracy of Mohale's Hoek. It is the extreme western point of the great Mokhele range. It is about 7,500 feet high. The bridle-path from Mohale's Hoek to Moyeni leads over the plateau from which the mountain rises, between the plug and what is presumably the old crater wall. It is a typical volcanic vent, and one can trace the outflow of the lavas on the north side of the hill. At one point where a stream has cut through, they are steeply inclined, glassy, and weather into coarse splintery fragments about 10 or 12 inches in length, not unlike spear-heads. At another place, a little higher up, they are ropy and scoriaceous. The whole crest of the mountain consists of doleritic amygdaloid lavas, interbedded with vesicular varieties and very thick beds of ash. The vesicles in the lavas are generally filled with calcite. An exposure of the junction of the lavas and the Cave Sandstone occurs in the bridle-path upon this mountain, and indicates that erosion of the Cave Sandstone had taken place before the deposition of the Volcanic Beds, but the evidence is not decisive. The erosion may be due to a subsequent and different cause. This does not apply to an exposure near Sefikeng, which plainly indicates erosion. Many of the highest

summits, such as Mount Hamilton, Mont aux Sources, Bitsolebe, etc., contain a vertical thickness of over 4,000 feet of lavas and ashes. These mountains, with the exception of the last, are situated in very difficult and broken country, far from centres of population, and as I have not visited them personally I am unable to describe them in detail.

Connected with the lava beds are a great series of intrusive dykes and sheets. They cover a considerable extent of country, and traverse all the Stormberg Series. They are subsequent to the Volcanic Beds, and so far as I can make out are of the same age as the Karroo dolerites of the Cape Colony and of similar composition. Amongst the many scores of them that I have examined I cannot say that I have ever observed any decided characteristics of a lava-flow. Doleritic lava can be generally separated from doleritic intrusions, not only by its appearance but also by its mode of occurrence. A doleritic sheet weathers red, which doleritic lavas never do, at least so far as I have seen them. Some of the dykes are only a few inches wide, and upwards of 50 feet long, sending out side branches. By far the larger number are from 10 to 20 feet in thickness and several miles in length. They traverse the country in all directions like great roads running up and down the hills, and usually terminating in a large sheet. There are many examples of this kind, as for example at the mountain Thaba Tsuen. It crops out in the valley to the west of the cone; sends two parallel dykes up the mountain at very steep angles, and separated by rather less than a mile. These dykes traverse the lower lava beds, reappear on top as two shallow parallel trenches, and then pass into an immense sheet nine or ten miles in length by four in width, which attains in places a thickness of 400 feet. Near Mohale's Hoek two remarkable examples of intrusive dykes are to be seen. The first runs across the country with perpendicular sides like a huge wall for about seven miles, traversing the lavas of the Mokhele range. At one point where a stream has cut through the side of the dyke the dolerite assumes a columnar structure closely resembling basalt. The Molteno sandstones through which it has broken are much altered. The other dyke is a conspicuous feature of the landscape, and runs in an east and west direction for upwards of 15 miles from the volcano Mokhele to Raboroko. It is perfectly straight, 30 feet thick, and about the same in height, but more must be hidden by superficial accumulations. It stands up in the form of a huge causeway, and is much weathered at the top and sides, the nodules ranging in size from a marble up to masses two feet or more in diameter. The edges of the rent into which the molten dolerite has been injected are as clean-cut and straight as if laid out artificially. Small displacements of the neighbouring strata are characteristic features of these dykes. Occasional enclosures of sandstone occur in dykes, but they rarely exceed three feet in thickness. From observations made at widely separated places, I am convinced that these dykes and sheets were intruded into the lavas long after volcanic action had ceased, at least from the main centres of eruption, but before the earth-movements to which the country largely owes its present configuration had begun.

Recent and superficial deposits cover the low grounds, and consist

of stratified clays, sands, and gravels. The pebbles of the gravels consist of fragments from all the Stormberg rocks. In many places these deposits are more than 30 feet thick. The rivers in the course of ages have cut their way through them, and, as they are loose and easily removed, the amount swept away by every storm is considerable. Large masses fall from the banks during the rains, with the result that a small stream becomes in a short time a huge gaping donga. These dongas everywhere intersect the country, and are a positive danger, especially during the rainy season. The destruction of the wood and bush of the country, together with the increase of cattle that eat off the grass, has powerfully assisted the formation of these dongas. They not only reduce the area of arable land, but also drain off the water and disfigure the country. If nothing be done to check their formation they will render the water problem a very serious one at no distant date. When the first missionaries came to Basutoland about 75 years ago multitudes of these dongas did not exist. A deep donga near Morija was forty years ago a small stream that one could step across; now it is a trench 15 feet deep and more than 20 feet wide. It is a pity that the Basuto cannot be induced to plant trees more extensively. They would at least do something towards checking denudation, besides being useful as fuel in a country where such a commodity is exceedingly scarce. The Government is trying to induce the natives to plant by the gift of trees, and they are slowly waking up to the necessity of it.

The most interesting of the superficial deposits are the sand dunes on Thaba Bosin mountain. They occupy the south-eastern portion of the plateau, and travel east or west according to the direction and strength of prevailing winds. These sand dunes are formed of disintegrated Cave Sandstone, the grains being chiefly quartz and felspar. They cover many acres in extent. Thaba Bosin is the necropolis of the Basuto chiefs, and every paramount chief, besides many sons and brothers of the ruling chiefs, have been buried there. The sand-hills have partially covered up the graves and appear to be slowly travelling towards the east, as some of the graves formerly hidden are now exposed. They never approach close to the precipitous edge of the plateau, as apparently the updraught of the wind in rushing round and over the plateau prevents the sand from falling over the precipice. They are also beautifully ripple-marked by the wind, and some of them are quite 20 feet in height. Not far from Morija there is the basin of an old lake, just as there are many such prehistoric lake basins over the surface of the country, in which there have been found Palæolithic flint implements. Some of the floors upon which these flint implements have been found are 60 and 70 feet above the present levels of the rivers. The lake basin referred to above is now quite filled up, and is only represented by a marsh, as the river which formerly drained it has cut a deep channel for itself, removing the surplus waters. It is about six square miles in area, and the beds of sand and gravel filling it up are well exposed in the bed of the stream. They are over 30 feet thick. This lake existed from a remote period until quite lately. It ought to be a likely place for fossils, but none have been found. A few fossils have been discovered in other gravels in various

parts of the country, belonging, so far as is known, to species still living, but some of which no longer inhabit the country. The skull of a hippopotamus was obtained many years ago from the bank of the Caledon River near the station of Hermon, and I am informed the remainder of the skeleton is still there, as the people objected to its removal. Tusks of the warthog, together with scattered bones of other animals, have also been found. The warthog is quite extinct in Basutoland, and has been for a considerable time. It is probable from the age of some of the oldest of these deposits that recently extinct animals might also be found.

So far as can be seen it is probable that the drainage of the country, from the time of its elevation at the close of the Stormberg Period, has followed pretty much its present lines. A glance at the sectional map of the country, from Morija to the Natal border east and west, compiled by the Rev. R. H. Dyke from notes made by him in 1883 and 1884, will show this.[1] The Caledon River flows in a shallow syncline tending east-north-east, and there is no trace of any change in the direction in recent times. The same may be said of the Orange River and its tributaries, which have cut their way through the plateaux and formed steep-sided valleys nearly 2,000 feet deep, and in some places much deeper than that. On the Maletsunyane River, a tributary of the Orange, there is a magnificent waterfall 632 feet high, formed by the river cutting back its bed. Ages of denudation have hollowed out deep troughs, in the bottom of which the rivers now run with a general southerly direction, carving the volcanic beds into three and in some places four parallel ranges. This has been powerfully assisted by earth-movements subsequent to the cessation of volcanic activity. There have been two distinct thrusts. First one from east to west, giving the Stormberg Beds their general easterly dip, next one approximately at right angles to this. The first produced the series of synclinal folds, which the country presents on traversing it from the Caledon River to the Drakensberg; the second gave a gentle rise to the country from south to north, assisting the rivers to deepen their beds.

A good example of river erosion on a small scale is to be seen near the station of Hermon in the west of the country, where a small tributary of the Caledon has cut its way through a doleritic intrusive sheet 200 feet thick, and there is no indication that the stream ever followed any other course. The best examples of river erosion are to be seen in the gorges of the Malutis, but I have never had the good fortune to visit them. The scenery of these parts of the country is remarkably grand in places, and well merits the title bestowed upon it of the Switzerland of South Africa.

[1] Published in "Papers read at the joint meeting of the British and South African Associations for the Advancement of Science, 1905," vol. ii, p. 129.

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